Every Student Counts

Professional Development Guide
Elementary School Level

Year 1 - Day 2

Iowa Department of Education

Elementary Session – Facilitator Plan
Year 1 Day 5

Content Goal:
NCTM Algebra Standard

Understand Patterns
- (K-2) Sort, classify, and order objects by size, number, and other properties;
- (K-2) Recognize, describe, and extend patterns such as sequences of sounds and shapes or simple numeric patterns and translate from one representation to another;
- (K-2) Analyze how both repeating and growing patterns are generated.
- (3-5) Describe, extend, and make generalizations about geometric and numeric patterns;
- (3-5) Represent and analyze patterns and functions, using words, tables, and graphs

Process Goal:
Representation Standard K-12

- ♦ (K-5) Create and use representations to organize, record, and communicate mathematical ideas;

- ♦ (K-5) Select, apply, and translate among mathematical representations to solve problems;

- ♦ (K-5) Use representations to model and interpret physical, social, and mathematical phenomena.

Overall Teaching Goal:

- Teaching and learning mathematics through problem solving

Activity	Description for facilitator	Time (min)	Materials
1. Discussion on Principles and Standards of Mathematics reading assignment	• Participants will discuss the representation standard using these questions: Use of manipulatives is often expected to increase scores on tests and improve retention. Does manipulatives guarantee success? Why or why not? • What are the implications for us?	30	Article: *Concrete Materials and Teaching for Mathematical Understanding* by Patrick Thompson found in Putting Research into Practice in the Elementary grades. **TM- 1** Reflection on PSSM readings
2. Introduction	• Participants discuss "What is Algebra?" • Participants read and discuss *Doing Algebra K-4* by Usiskin to	20	Article from Navigating Through Algebra Grades 3-5 "Doing Algebra K-4" PSSM standards Quick Card

	form a definition for algebra and variables. • Discuss the variation in the standards from K-2 to 3-5 to 6-8 • Show growth of emphasis overhead		**TM-6** K-12 content strands from NCTM
3. Understand Patterns, Relations, and Functions	Participants will experience activities and one assessment for the following K-2 Expectations from NCTM • Sort, classify, and order objects by size, number, and other properties • Recognize, describe, and extend patterns • Analyze how both repeating and growing patterns are generated	95 min.	Classification sets; **TM-2** – Levels of Classification **TM-3** Patterning Questions pattern strips; pattern blocks, matrix boards, Venn diagram hoops, Attrilinks,
4. Homework discussion on problem-based instruction	• Participants will discuss readings from *Teaching Mathematics through Problem Solving:* What characterizes a classroom in which a teacher is actively engaged in using a problem-solving curriculum? What issues and decisions must teachers face? What kind of staff development needs to occur to help teachers teach this way? Tables will record characteristics. • Share classroom experiences with fraction and decimal content from last session.	45 min.	Chart paper and markers **TM-4** Reflection on readings **TM-5** Factors of Decline in Cognitively Demanding Tasks
5. Understand Patterns, Relations, and Functions	Participants will experience activities for the following 3-5 Expectations from NCTM • Describe, extend, and make generalizations about geometric and numeric patterns • Represent and analyze patterns and functions using words, tables, and graphs	95 min	See "Patterns and Functions" - *Bridges Unit* graph paper Pattern blocks Overheads and handouts from *Bridges Unit* Interlocking cubes for demonstration. **TM-7** Five Representations of a Function

Summary - Day One of Year One:

In the first activity, participants discuss the Representation standard by discussing the proper use of manipulatives. In the second activity, participants discuss what algebra is and define a variable. Activities for classification and sorting will be demonstrated following the discussion. A Bridges Unit called "Patterns and Functions" comes next and is continued after lunch. Discussion of problem-based instruction pitfalls and ways to maintain high cognitive demand of tasks will be an after lunch activity.

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Facilitator's Tools for Planning the Session

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What is the required background reading? Read the Staff Developer's Guide for this section. In addition, read page v in *Navigating through Algebra in Prekindergarten-2* and page v in *Navigating through Algebra in Grades 3-5*.
What equipment and materials should participants bring? The instructor will need classification sets such as plastic animals or collections and pattern strips. Each participant will need a pattern blocks, paper, pencils and masking tape and centimeter graph paper.

What other teaching supplies/materials/technologies are needed?. Practice each example that you will show using the manipulatives.

Handouts
> Article titled, *Concrete Materials and Teaching for Mathematical Understanding* by Patrick Thompson
> Article from Navigating Through Algebra 3-5 *Doing Algebra K-4* by Usiskin
> **TM-2** – Levels of Classification
> **TM-5** Factors of Decline in Cognitively Demanding Tasks
> **TM-6** K-12 content strands from NCTM

Overheads
> **TM-1** Reflection on PSSM readings
> **TM-3** Patterning Questions Overhead 3 - Patterning Questions
> **TM-4** Reflection on readings from *Teaching Through Problem Solving K-6*
> **TM-5** Factors of Decline in Cognitively Demanding Tasks
> **Bridges Unit**
> Overheads 1-9 in Bridges Unit " Patterns and Functions"
> **TM-7** Five Representations of a Function

Activity 1 – Discussion of Representation Standard   **Time**: 30 min.

Rationale
Participants will discuss the issue of manipulative use.

Connections:

Materials:
TM-1 Reflection on PSSM readings
 Concrete Materials and Teaching for Mathematical Understanding

Conducting the Activity:
Points to include in discussion:
- ♦ Results are mixed on the effectiveness of manipulatives.
- ♦ Teachers are the variable.
- ♦ Manipulatives do not automatically carry mathematical meaning.
- ♦ The nature of classroom talk should be to think about the materials and the meanings of the various actions with them.
- ♦ Various interpretations of the materials should be explored.

Use of manipulatives is often expected to increase scores on tests and improve retention.
Do manipulatives guarantee success? Why or why not?

What implications are there for us?

Activity 2 – Introduction to Algebra Standard　　　　**Time:** 20 min.

Rationale:
Participants will write their own definitions for algebra and variables. These will be shared in a think-pair-share activity. The article *Doing Algebra K-4* by Usiskin will then be read and our definitions expanded. Teachers often think of solving equations when thinking of algebra. The expanded definition should include the uses of algebra to write formulas, express relationships, give us rules for arithmetic and to model complex situations. The idea that a variable can be used in all these ways is a key concept.

The Algebra Standard will be discussed as a K-12 flow showing an overhead for the changes in emphasis. The differences and similarities in the standard from grades K-2 to 3-5 to 6-8 should be examined using the standards charts each participant has.
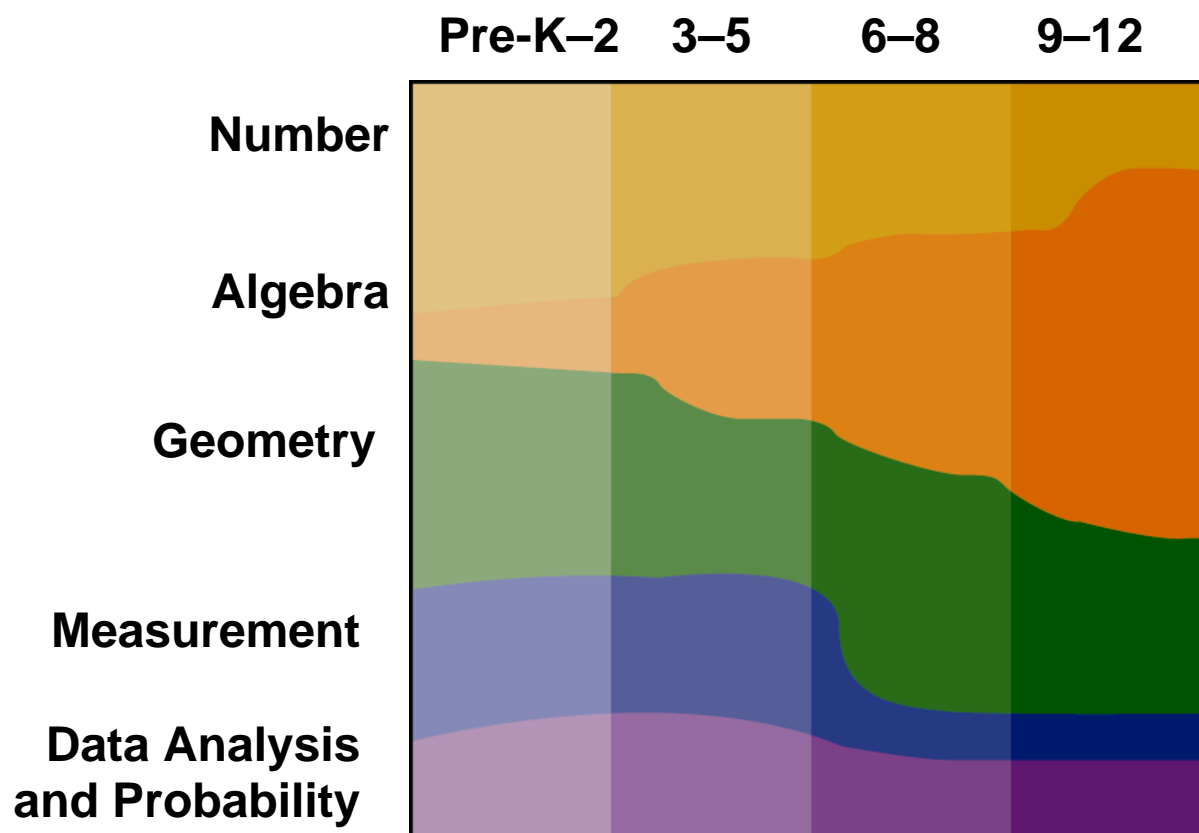
Connections

Materials:
Article from Usiskin
TM-6 K-12 content strands from NCTM
PSSM standards Quick Card

Emphasis Across the Grades

from *NCTM Outreach Kit, 2000.*

Activity 3 Understanding Patterns, Relations and Functions   **Time**: 95 minutes

Rationale
Participants will sort, classify, and order objects by size, number, and other properties using classification sets. They will learn and practice an assessment for classification, "Class Inclusion". They will recognize, describe, and extend patterns using pattern strips and the hundreds' board. They will analyze how both repeating and growing patterns are generated using an activity from *Navigating through Algebra in Prekindergarten-2*.

Connections

Materials:
Classification sets;
TM-2 – Levels of Classification
TM-3 Patterning Questions
 pattern strips; pattern blocks, matrix boards, Venn diagram hoops, Attrilinks,

Activity 4 Discussion of reading   **Time: 45 minutes**

Rationale
Participants will consider problem-solving classroom features by charting characteristics found in the reading assignment in the resource and hearing about research around maintaining the high cognitive demand for tasks. A part of this time will be spent sharing classroom practice assigned in last session.

Connections
This set of discussion questions can be used to assess participants understanding of the problem-based curriculum. This is also a model of how group work can be assessed in the classroom in a formative way.

Materials
Chart paper and markers
TM-4 Reflection on readings
TM-5 Factors of Decline in Cognitively Demanding Tasks

Conducting the Activity

Have teachers complete a poster in their own groups that reflects the content of the questions. Encourage the use of a metaphor for those who prefer a visual representation. Allow each group to share. After discussion, summarize and show **TM-5** Factors of Decline in Cognitively Demanding Tasks to emphasize how important the behaviors of the teacher are in a problem-based classroom.

Points to include:
- Using cognitively demanding tasks in the classroom requires attention to students' prior knowledge and scaffolding when necessary. Allowing too much time before scaffolding occurs results in decline.
- Sustaining high pressure for explanations and meaning from students needs to be practiced and part of conscious effort by the teacher.
- Emphasis on finding the correct answer can create decline of a task. This represents the factor most often found in decline of the cognitive demand for a task. When present with allowing too little time, cognitive demand declines rapidly.
- Notes:
1. Students know ideas are valued.
2. Mathematics is about thinking through ideas or sense making.
3. Teachers analyze discussions and behaviors in order to decide on focusing on an essential idea.
4. Teacher modifies curriculum to match growing understanding.
5. Teacher uses mistakes to instruct.
6. Motivating reluctant learners includes finding an entry point and representations that work for the child.
7. Teacher uses fewer but richer tasks.

1. What characterizes a classroom in which a teacher is actively engaged in using a problem-solving curriculum?

2. What issues and decisions must teachers face?

3. What kind of staff development needs to occur to help teachers teach this way?

TM-5 Factors of Decline in Cognitively Demanding Tasks

<This is not electronic. Please insert document called USING COGNITIVELY COMPLEX TASKS and include footnote:

from Reflections on Elementary and Middle School Mathematics, 2001.>

Activity 5   Patterns and Functions Bridges Unit   Time: 95 minutes

Rationale
Participants will practice looking for patterns; representing patterns and understand how patterns relate to a function.

Connections
Students need to see all the translations between the five representations of a function to make the connections and use them in problem solving. This relates to the Representation Standard skill: (K-5) Select, apply, and translate among mathematical representations to solve problems.

Materials
TM-7 Five Representations of a Function
See "Patterns and Functions" - *Bridges Unit*
Graph paper
Pattern blocks
Overheads and handouts from *Bridges Unit*
Interlocking cubes for demonstration.

Conducting the Activity
Show **TM-7** Five Representations of a Function and relate to earlier diagram of 5 translations from Day 1 of Year 1. Follow the instructions for the three of the four activities in the Bridges Unit "Patterns and Functions". The fourth activity is a good one to use in a team assignment or as an extra practice of content learning.

Five Representations of a Function

Graph

Tables/Charts

Models/ Context

Expression/ Equation

Written and Oral Language